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GB 1395742 A

(58) Field of search
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INT CL^5 H02K 1/04 1/14 1/18 15/02 15/10

(54) Moulded stator assembly for an electric motor

(57) A stator is formed from a magnetic circuit comprising laminations 60 embedded in a non-magnetic moulded material 34, the straps 18–25 interconnecting the pole teeth 26–33 being severed during the removal of material 34 to form notches 41–48 to permit pole windings to be inserted into the recesses 2–9 from the exterior of the stator. A yoke member 51 is fitted to the outer periphery of the stator in engagement with the laminated stack, projections 52–59 entering the notches 41–48.

FIG. 1

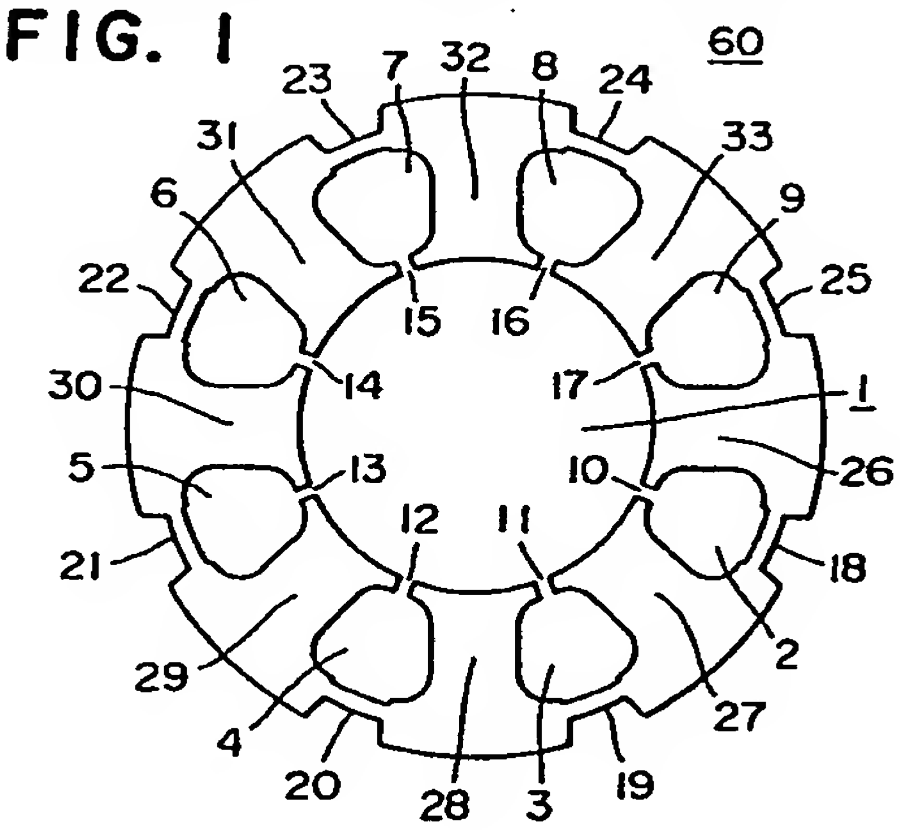

FIG. 5

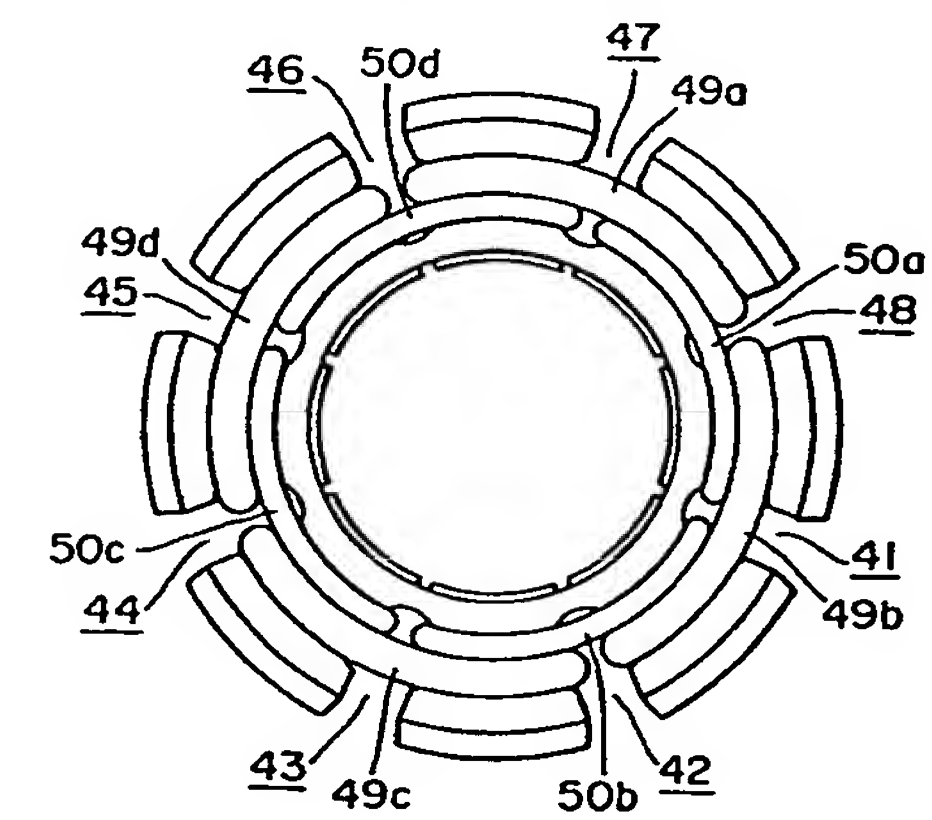

FIG. 2

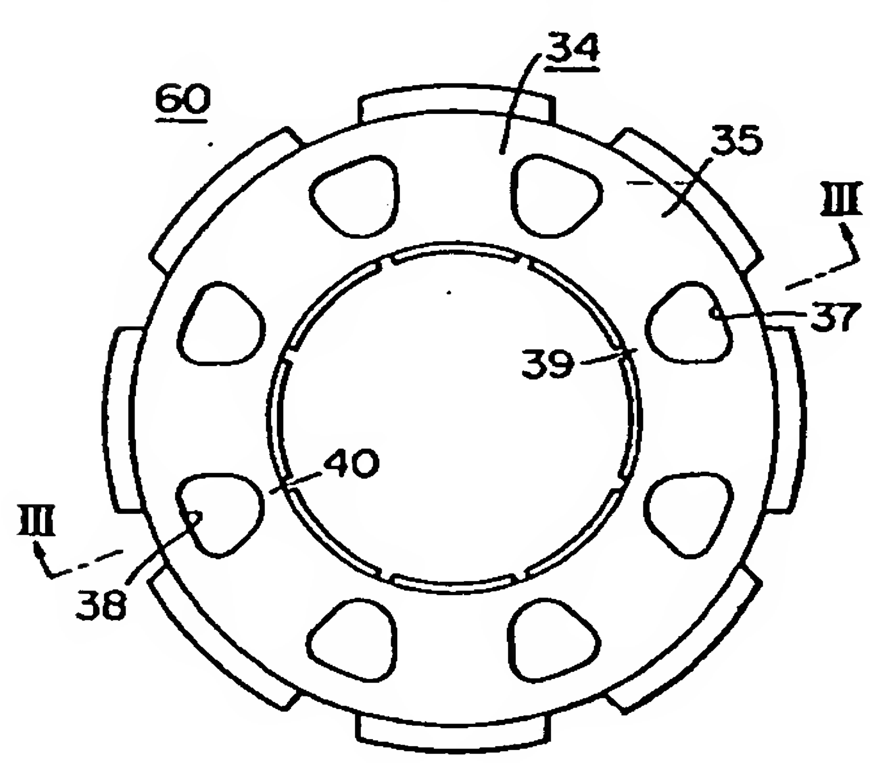

FIG. 6

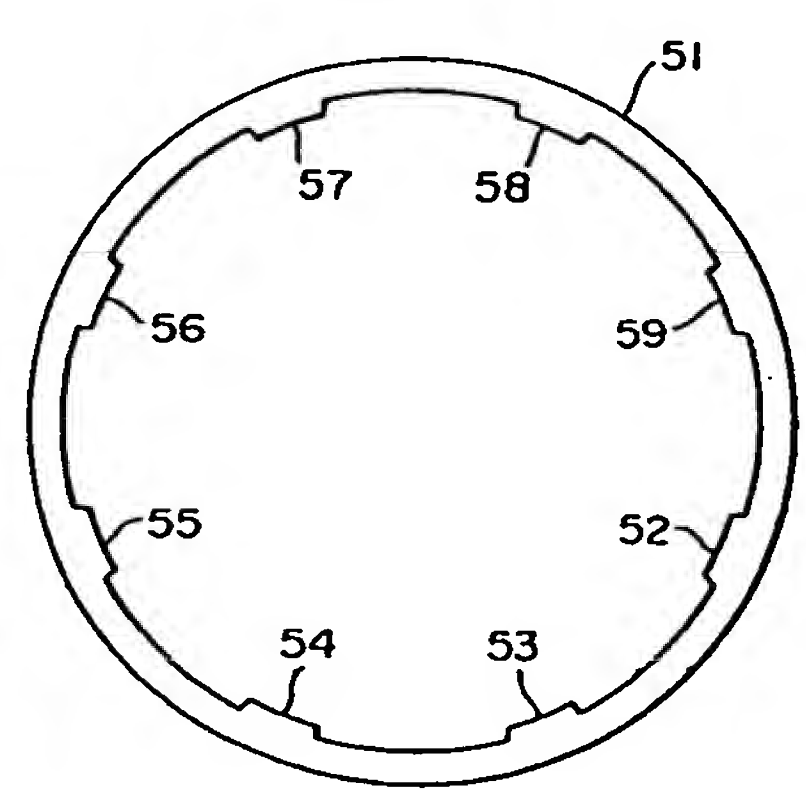

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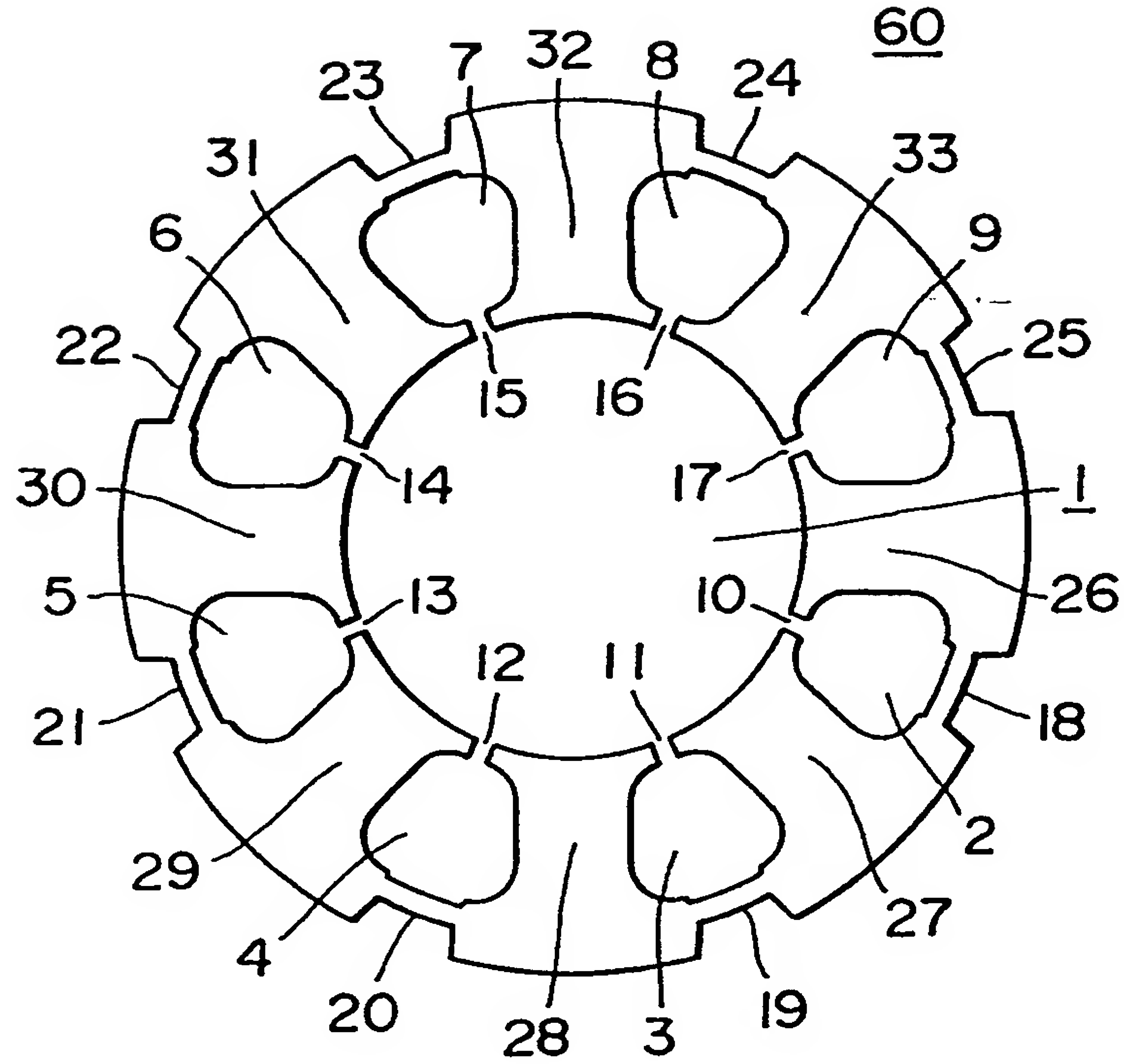
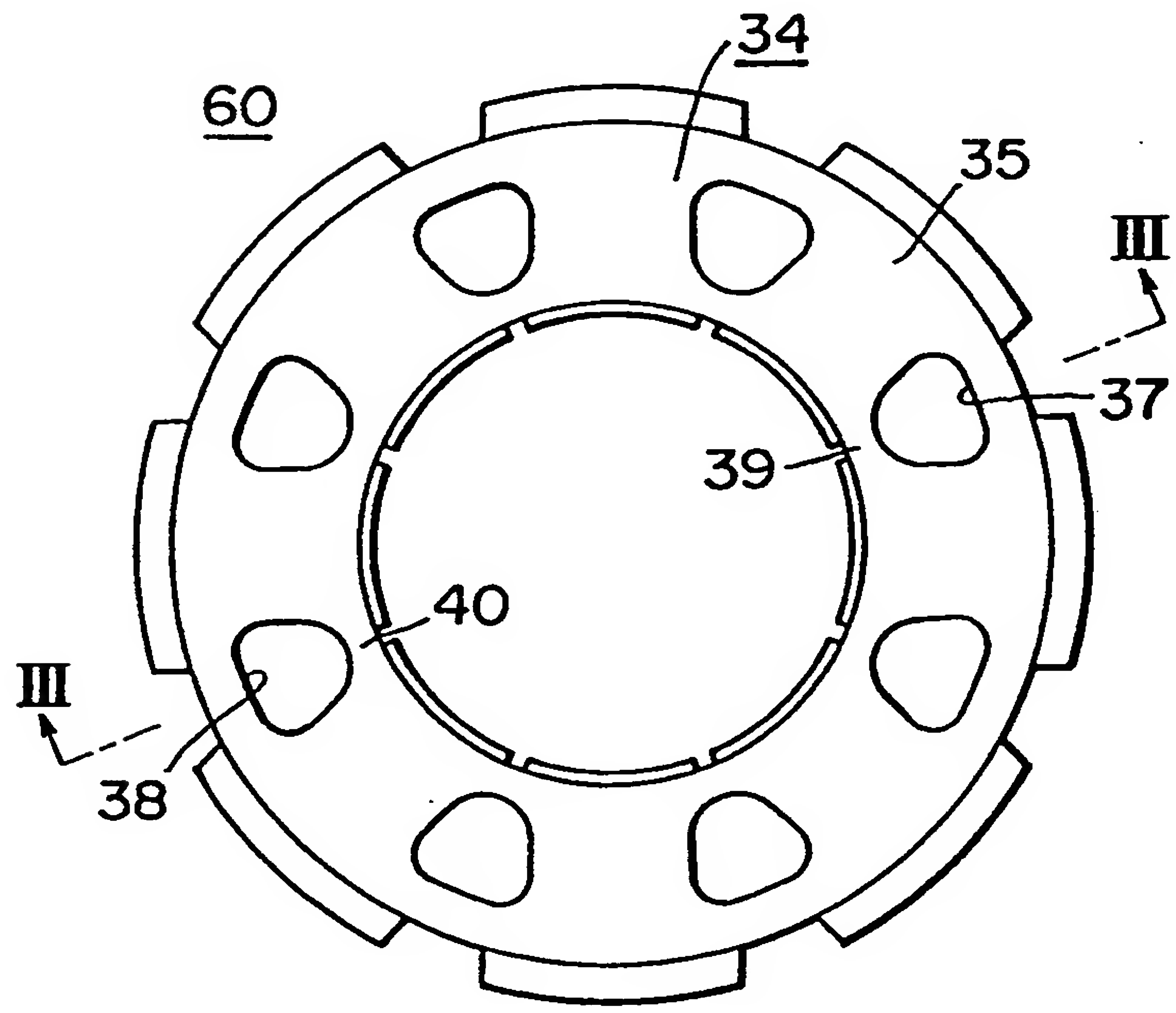
FIG. 1



60
23
7
32
8
24
31
33
6
9
22
25
15
16
14
17
30
1
26
5
13
10
21
12
11
18
29
2
27
4
20
28
3
19

FIG. 2



34
60
35
III
37
39
40
III
38

FIG. 3

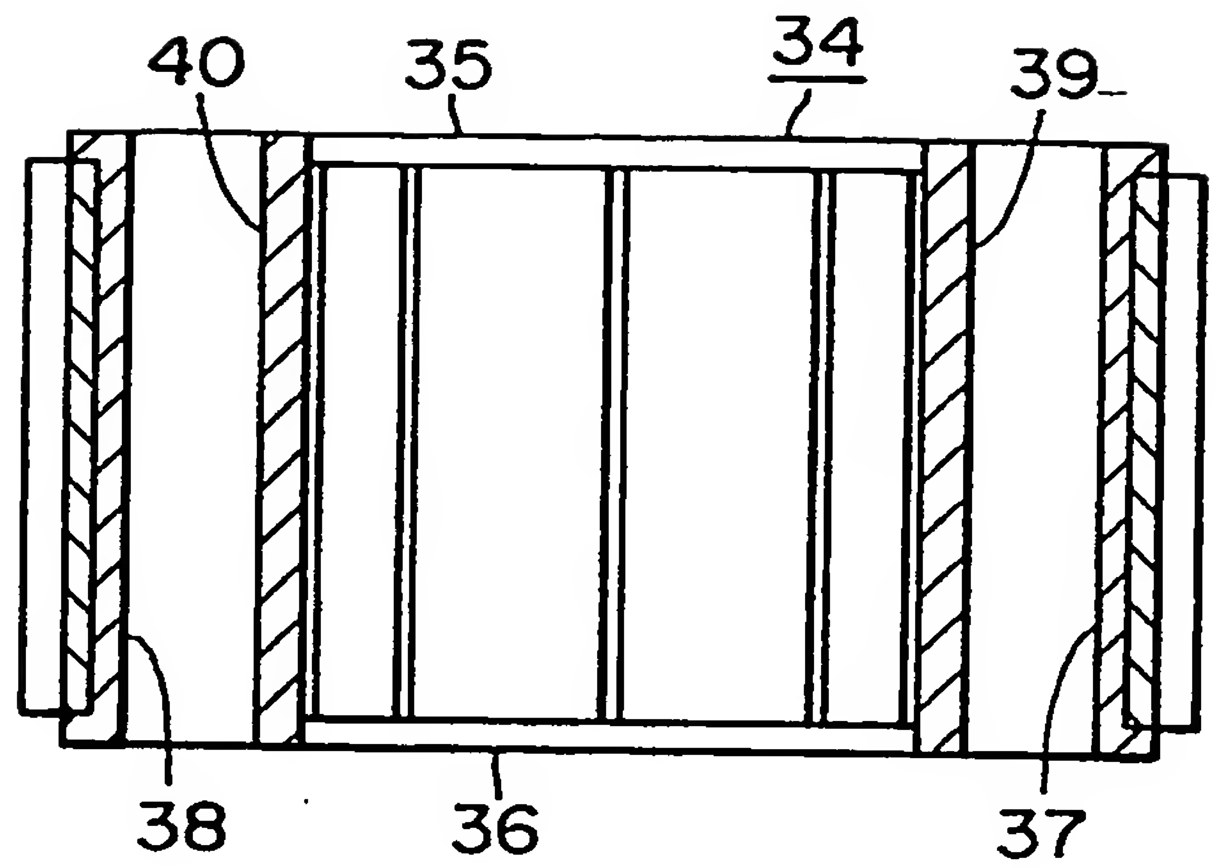


FIG. 4

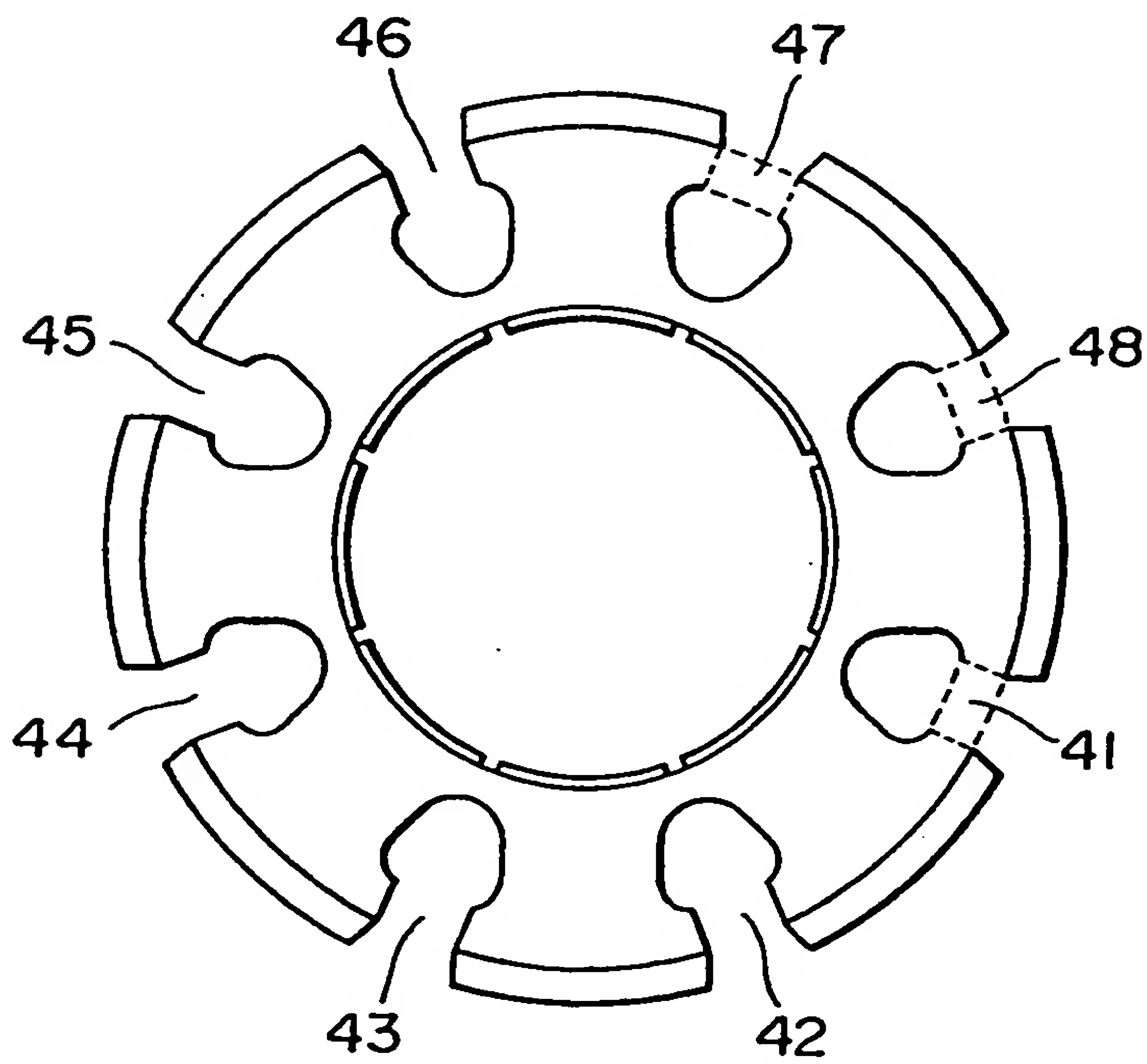
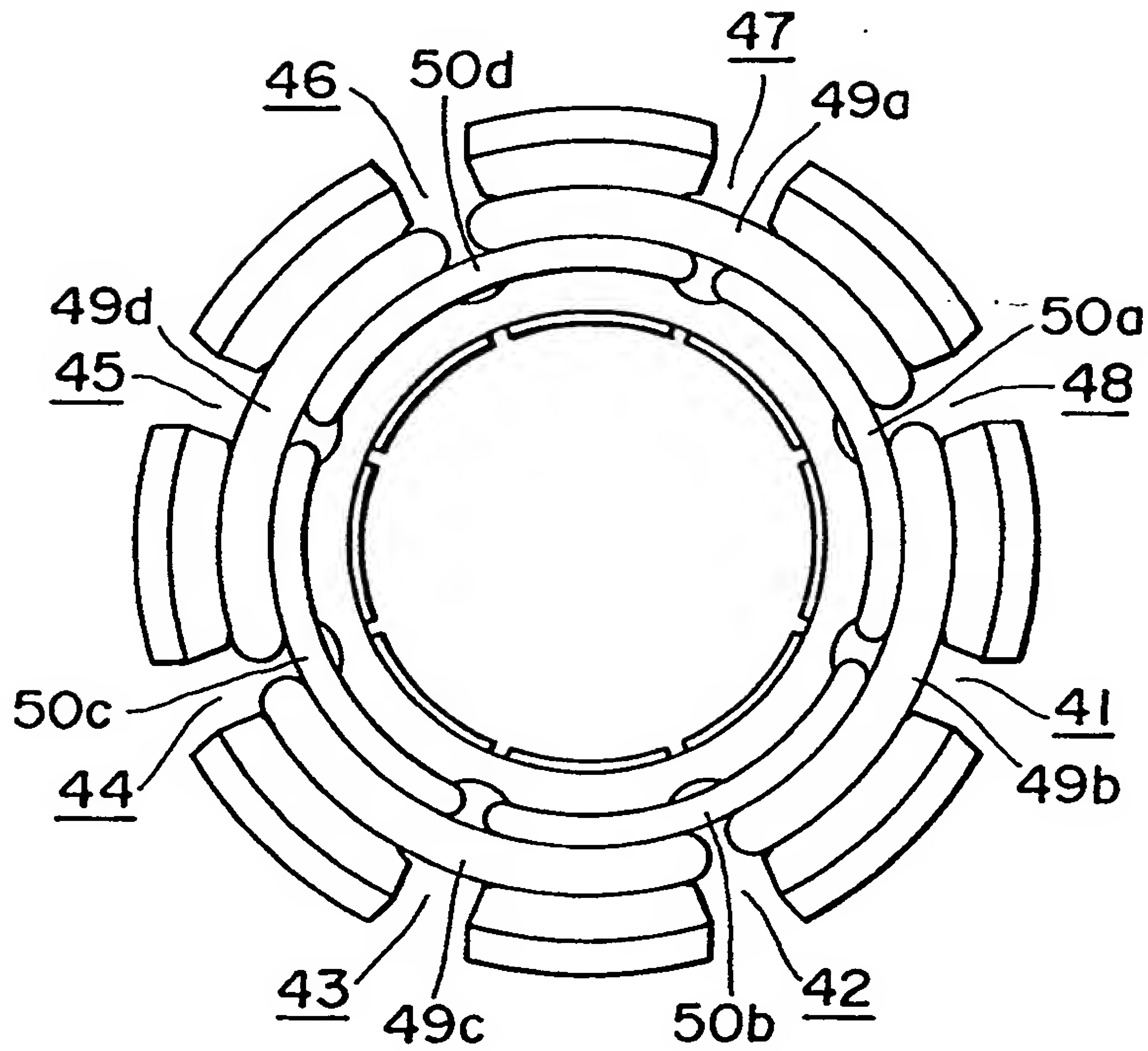
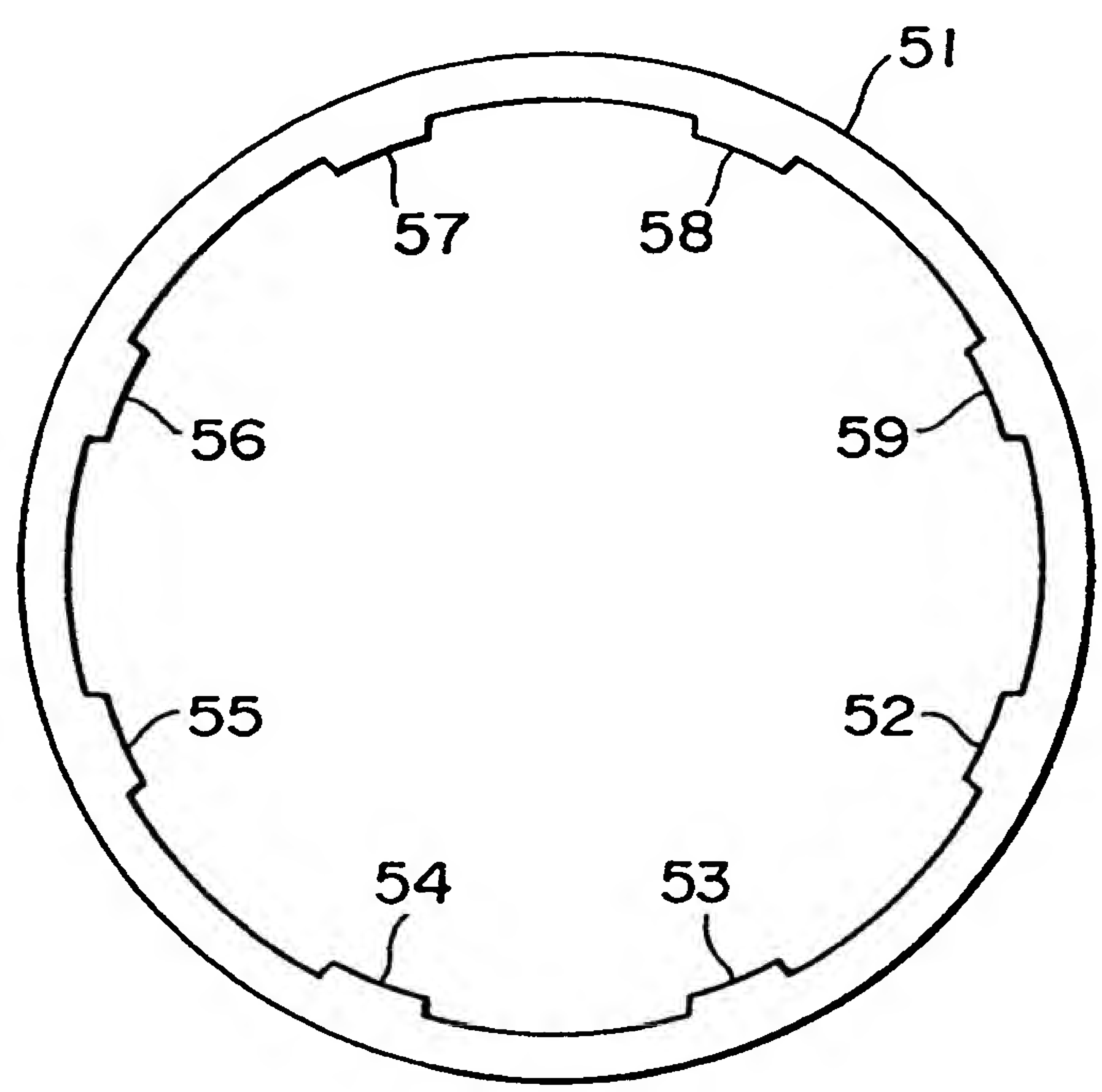


FIG. 5



46
50d
47
49a
49d
50a
45
48
50c
41
44
49b
43
49c
50b
42

FIG. 6



51
57
58
56
59
55
52
54
53

FIG. 7

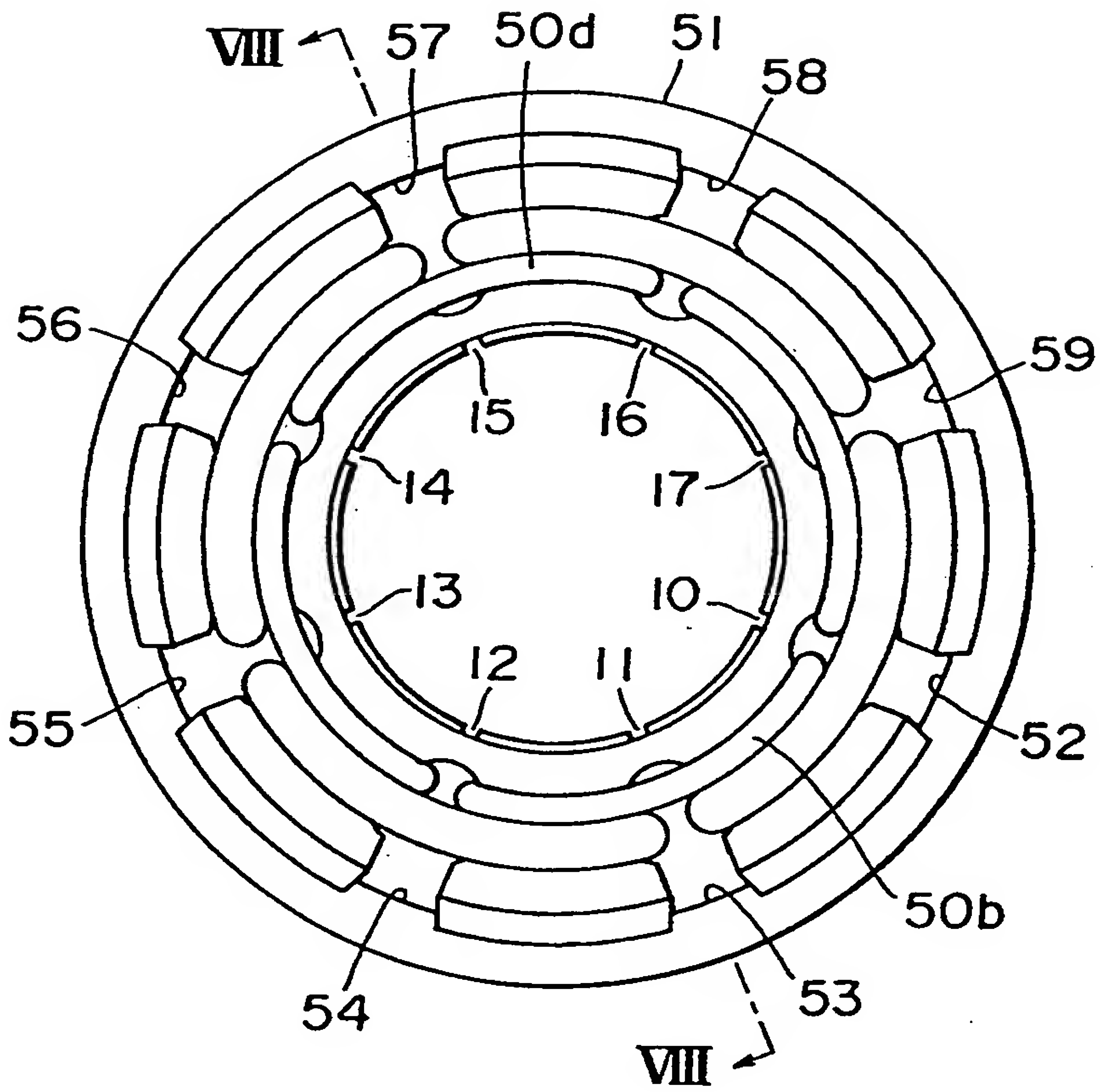
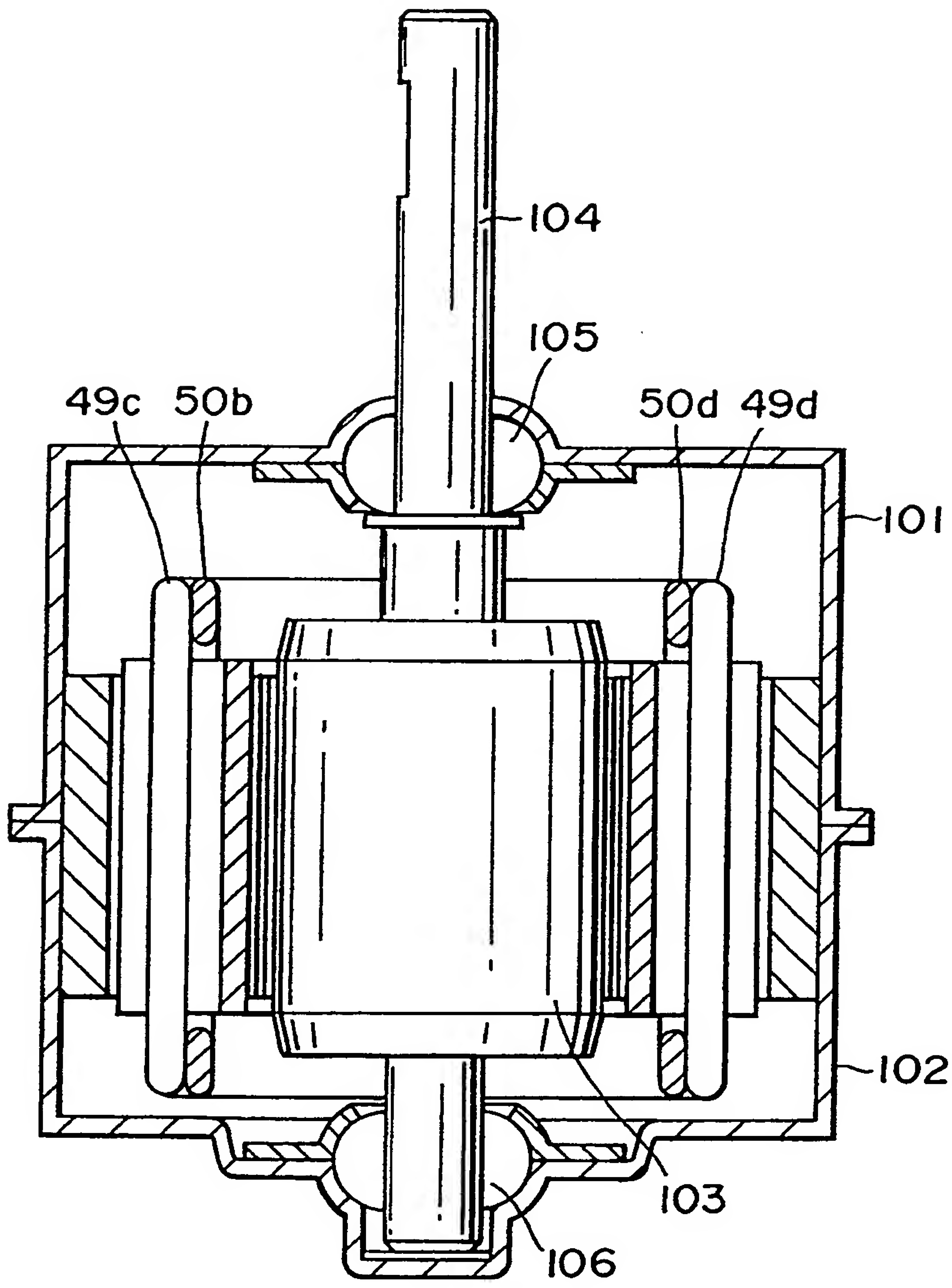


FIG. 8



AN ELECTRIC MOTOR AND METHOD OF PRODUCING THE SAME

The present invention relates to an electric motor, and more particularly to a stator for a small-sized electric motor and provides an improved stator and a method of producing the stator.

A conventional stator for use in an electric motor of small size is disclosed in Japanese Patent Publication No. 52-79207 (unexamined), published July 4, 1977. The conventional stator is produced by the steps of placing core plates having a ring-shaped link unit around a centrol bore for rotatably receiving a rotor and teeth interlinked with the link unit, laying the core plates to form a stator core, winding stator wires on the teeth from an outer periphery of the stator core, and forcing the stotor core into a ring core.

In the conventional stator of the Japanese publication, the ring-shaped link unit is used to hold the teeth in position, so that the link unit can prevent the teeth from being separated from the link unit. Thus, efficiency of assembling the stator is improved at the same time.

One of the problems inherent to the conventional stator resides in leakage of magnetic flux. In other words, since the ring-shaped link unit and the teeth are unitarily press-formed of the same material, the magnetic flux

produced in the teeth tends to leak through the ring-shaped link unit and the ring shaped link unit develops into a magnetic "bridge", thus the operational efficiency of the motor is lowered.

An object of the present invention is to provide an improved motor which can prevent the magnetic flux from leaking out of the teeth of the stator.

Another object of the present invention is to provide a new stator in whish openings of the teeth of the stator core toward the rotor can be shielded with a nonmagnetic insulating resin so that leakage of the magnetic flux can be prevented.

In the present invention, an electric motor has a rotor and a stator having a bore for rotatably receiving the rotor. The rotor has a non-magnetic mold member which forms the bore inside thereof. A plurality of teeth are fitted to an outer circumference of the non-magnetic mold member at a constant circumferential interval, and a plurality of slots are formed between the adjoining teeth. Stator wires are inserted into the slots and an annular yoke is forcibly fitted to an outer circumferential portion of the teeth so that a magnetic path is formed between the adjoining teeth.

In the method of the present invention, a stator core having slots and teeth is formed so that the slots are interlinked with a bore of a stator. The stator core is

molded with synthetic resin so that openings of the slots is closed with the synthetic resin and the teeth are held by the synthetic resin. Notches are formed on an outer circumference of the stator core so that the notches are extended to the slots, and stator wires are inserted into the slots. An annular yoke is fitted over the outer circumference of the stator core so that annular yoke closes the notches. Thus, a magnetic path can be formed between the adjoining teeth.

According to a preferred embodiment of the present invention, there is provided an electric motor comprising:

a rotor, and

a stator having a bore for rotatably receiving said rotor,

wherein the stator comprises:

a non-magnetic mold member,

said non-magnetic mold member forming said bore inside thereof,

a plurality of teeth fitted, at a constant circumferential interval, to an outer circumference of said non-magnetic mold member, to thereby form a plurality of slots between adjoining teeth of said plurality of teeth,

stator wires inserted into said slots, and

an annular yoke forcibly fitted to an outer circumferential portion of said teeth to form a magenetic path between adjoining teeth of said teeth.

Further, in a preferred embodiment of the invention,

there is provided a method of producing an electric motor with a rotor and a stator having a bore for rotatably receiving said rotor, a non-magnetic mold member having said bore inside thereof, a plurality of teeth fixed to an outer circumference of said non-megnetic mold member at a constant circumferential interval to form slots between the adjoining teeth, stator wires inserted into said slots, and annular yoke forcibly fitted to an outer peripheral portion of said teeth to form a magnetic path between the adjoining teeth, comprising the steps of:

forming a stator core having said slots and said teeth, said slots being interlinked with said bore through an opening,

molding said stator core integrally with synthetic resin, said synthetic resin overlying upper faces and lower faces of said stator core and inner surfaces of the slots, said synthetic resin forming said non-magnetic mold member, said non-magnetic member closing said openings and contacting an end of said teeth at the side of said bore,

forming notches on an outer periphery of said stator core molded by said synthetic resin so that said notches are extended to said slots,

winding stator wires so that said stator wires are wound in said slots through said notches from an outer circumference of said stator core molded with said synthetic resin, and

fitting an annular yoke over the outer periphery of said

stator core so that said annular yoke closes said notches after said stator wires are wound in said slots.

Fig. 1 is a top plan view of an iron core for a stator according to an embodiment of the present invention,

Fig. 2 is a top plan view of the stator core of Fig. 1 after it is molded, showing slots at a circumferential interval,

Fig. 3 is a sectional view taken along III-III in Fig. 2,

Fig. 4 is a top plan view of the stator core provided with notches extending from a circumference to the slots,

Fig. 5 is a top plan view of the stator core with stator windings,

Fig. 6 is a top plan view of a yoke fittable to the circumference of the stator core shown in Fig. 5,

Fig. 7 is a top plan view of the stator core with the yoke fitted thereto, and

Fig. 8 is a sectional view of an electric motor incorporating the fotor according to the present invention, taken along VIII-VIII in Fig. 7.

Referring first to Fig. 1, a stator core 60 is formed of a plurality of laminated core plates. Each core plate is prepared by punchig an electrical steel plate having a thichness of about 0.5mm. The stator core 60 has a bore 1

for rotatably receiving a rotor (not shown) and slots 2 - 9 at a predetermined circumferential interval to form teeth 26 - 33 between the adjacent slots 2 - 9. The slots 2 - 9 have openings 10 - 17 at an inner circumference of the stator core 60 so that the openings 10 - 17 are connected to the bore 1. The openings 10 - 17 serve as air gaps between the adjacent teeth 26 - 33. As the air gap need only be wide for a satisfactory pole separation between the adjacent teeth, the width of the stator core 60 is made minimum for the improvement in the efficiency of the motor.

The stator core 60 has connection portions 18 - 25 on the outer circumferential portion to couple the adjacent teeth 26 - 33. Thus, the slots 2 - 9 are formed by the adjacent teeth 26 - 33 and the connection portions 18 - 25.

After a plurality of core plates are placed in layers to form a stator core 60 by, for example, providing several teeth with caulkings to make the stator core tight, the upper and lower edge portions of the stator core 60, the inner peripheral faces of the slots 2 - 9 and the openings 10 - 17 are integrally molded with resin, so that a part of the teeth 26 - 33, adjacent to the bore 1, is solidly formed with the resin. Further, a cylindrical part of resin is formed with respect to the rotor bore 1 by inserting the resin into the openings 10 - 17 between the adjacent teeth 26 - 33. If necessary, core plates having interlinked openings may be placed in the stator core 60 to increase the mechanical strength of the stator core.

With reference to Figs. 2 and 3, the stator core 60 has an insulating portion 34 of a suitable resin such as polybutylene terephthalate, nylon with or without reinforcement of glass fiber. The insulating portion 34 is composed of an upper insulating portion 35 for insulating the upper edge of the stator core 60, a lower insulating portion 36 for insulating the lower edge of the stator core 60, slot-insulation portions 37, 38 for insulating the solts 2 - 9, and portions, for example, portions 39, 40 for shielding the openings 10 - 17 of the slots. The portions 39, 40 and the upper and lower insulating portions 35, 56 are formed into a cylindrical shape at the side of the bore 1 so that the rotor bore 1 is surrounded by these portions.

Then, as shown in Fig. 4, the connection portions 18 - 25 (Fig. 1) and the resin overlying the connection portions are cut out from the outer periphery of the stator core 60 shown in Fig. 2 to form notches 41 - 48. The connection portions 18 - 25 and the resin overlying the connection portions are cut out by a method of slitting the stator core by means of a cutter while turning the slots 2 - 9 pitch by pitch or by a method of slot-to-slot punching the stator core. If the processing is carried out in such a way as to evade portions where burrs may be produced, generation of burrs and the like on the stator core can be prevented.

As each of the teeth 26 - 33 is held by the portions, for example, portions 39, 40 for shielding the openings 10 - 17, the inner peripheral portion of the slots 2 - 9, and the

resin formed on the upper and lower edge portions. Therefore, the teeth will not be dismembered or separated even if the connection portions 18 - 25 are cut off.

In Fig. 5 showing an embodiment of the stator for a single-phase induction motor, the stator core 60 has main windings 49a - 49d and subsidiary windings 50a - 50d. These windings are directly wound on the respective teeth by a suitable high-speed winding machine (not shown) while attaching winding quides (not shown) are set to the notches 41 - 48 after the stator core is held in position. Therefore, the breadth of the notches 41 - 48 can be made smaller if the breadth is large enough for operation of the winding machine. If necessay, terminal pins can be used so that leading and trailing ends of each winding can automatically be tied up onto the terminal pins and, thus, the winding operation can readily be automated.

In Fig. 6, a cylindrical yoke 51 is forcibly fitted to an outer circumference of the stator core 60 shown in Fig. 5. The yoke 51 has a plurality of projections 52 - 59 projecting radially inwardly toward a center of the yoke so that the projections 52 - 59 can shield the respective notches 41 - 48. The yoke 51 is prepared by punching electric steel plates of the same material as that of the stator core 60 and placing them in layers for lamination. The laminated stator core is caulked by means of caulkings which are provided in positions where magnetic resistance is low. If necessary, some ends of the projections 52 - 59 can

be formed unitarily by welding.

In Fig. 7 showing the stator with the yoke press-fitted to the outer periphery of the stator core shown in Fig. 5, the yoke 51 holds the ends of the teeth 26 - 33 in the area between the projections 52 - 59 to place the respective teeth in position.

A guide pin (not shown), together with the insulation portions, may be formed integrally on the edge face on the bore side of the teeth when the stator winding is wound in such a way that the winding does not shield in any way the rotor bore. This structure enables the coil end to be shaped simply after the rotor winding is wound.

In Fig. 8, the stator 60 is fitted into a brackets 101, 102 composed of two parts as shown and provided with rotor 103. The rotor 103 has a rotary shaft 104 rotatably supported on bearing metals 105, 106.

According to the present invention, the stator of a motor comprises the circular nonmagnetic material having the bore into which the rotor is inserted, the plurality of teeth radially fitted to the nonmagnetic material at equal intervals, the stator wires wound around the teeth, and the yoke fitted to the outer peripheries of these teeth in such a way as to link the adjoining teeth. Therefore, the yoke can be fitted after the stator wires are wound on the respective teeth from the outer periphery of the stator and this makes it unnecessary to wind the stator wires through the openings formed between the teeth on the rotor bore

side. The breadth of the opening can thus be reduced to the extent that no magnetic bridging is produced with the effect of improving the operational efficiency of the motor. In the case of a motor having smaller openings, further, cogging is reduced so that noise deriving from the vibration of the motor can be minimized.

The process of producing the stator according to the present invention comprises the steps of forming the stator core by placing the plurality of stator plates in layers, each stator plate having a plurality of slots arranged concentrically with each slot opened unidirectionally toward the rotary shaft of the rotor, shielding with nonmagnetic insulating resin the inner faces of the slots of the stator core, and faces of the stator core and the openings of the slots, subsequently forming a notch communicating with each slot from the outer periphery of the stator core, inserting the stator into the slots via the notches, and fitting the yoke over the outer periphery of the stator core. Therefore, the stator wires can be wound directly from the outer periphery of the stator core and this makes possible the high-speed winding for the stator wires since a winder is not restricted as compared with a case where the stator wires are directly wound from the inside on the rotor bore side.

As the opening between the teeth is shielded with the nonmagnetic material, the opening is free from magnetic bridging even though its breadth is decreased and the

reduced magnetic flux leakage contributes to improving the operational characteristics of the motor.

Moreover, the teeth are prevented from being dismembered and the integrated combination of the teeth can always be asesembled into the stator. Workability in assembling the stator is thus improved.

CLAIMS

1. An electric motor comprising:

a rotor, and

a stator having a bore for rotatably receiving said rotor,

wherein said stator comprises of:

a non-magnetic mold member,

said non-magnetic mold member forming said bore inside thereof,

a plurality of teeth fitted, at a constant circumferential interval, to an outer circumference of said non-magnetic mold member, to thereby form a plurality of slots between adjoining teeth of said plurality of teeth,

stator wires inserted into said slots, and

an annular yoke forcibly fitted to an outer peripheral portion of said teeth to form a magnetic path between adjoining teeth of said teeth.

2. A method of producing an electric motor comprising a rotor and a stator having a bore for rotatably receiving said rotor, a non-magnetic mold member having said bore inside thereof, a plurality of teeth fixed to an outer circumference of said non-magnetic mold member at a constant circumferential interval to form slots between the adjoining teeth, stator wires inserted into said slots, and annular yoke forcibly fitted to an outer peripheral portion of said teeth to form a magnetic path between the adjoining teeth,

comprising the steps of:

forming a stator core having said slots and said teeth, said slots being interlinked with said bore through an opening,

molding said stator core integrally with synthetic resin, said synthetic resin overlying an upper faces and lower faces of said stator core and inner surfaces of said slots, said synthetic resin forming said non-magnetic mold member, said non-magnetic member closing said openings and contacting an end of said teeth at the side of said bore,

forming notches on an outer periphery of said stator core molded by said synthetic resin so that said notches are extended to said slots,

winding stator wires so that said stator wires are wound in said slots through said notches from an outer circumference of said stator core molded with said synthetic resin, and

fitting an annular yoke over the outer periphery of said stator core so that said annular yoke closes said notches after said stator wires are wound in said slots.

-14-

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9209983.7

Relevant Technical fields

(i) UK Cl (Edition K) H2A (AKC4, AKC6A, AKC6, AKF2, AKH1)

(ii) Int CL (Edition 5) H02K 01/04, 01/14, 01/18, 15/02, 15/10

Search Examiner

J COCKITT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

30 JUNE 1992

Documents considered relevant following a search in respect of claims 1-2

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 1395742 A (SKF)	

Category	Identity of document and relevant passages	Relevant to claim(s)

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